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Final Technical Report

NSG-5203

1 December 1977 - 31 January 1979

"Geochemical Data Synthesis and Analysis"

(NASA-CR-158231) GEOCHEMICAL DATA SYNTHESIS AND ANALYSIS Final Technical Report, 1 Dec. 1977 - 31 Jan. 1979 (Hawaii Univ.) 6 p HC A02/MF A01 CSCL 08G

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HOW HOT PLAGIOCLASE?

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The possibility of using plagioclase-liquid partition coefficients for strontium and barium as geothermometers has been suggested on the basis of the strong temperature dependence exhibited in an experimental study in which plagioclase was crystallized from basaltic and andesitic liquids (Drake and Weill, 1975). However, application of the experimental results to partition coefficients determined for natural porphyritic lavas unexpectedly produced a large range of predicted temperatures and sizable disagreement between those predicted from Sr data and those from Ba. Kinetics was thought to have affected the Ba data in particular. However, when temperature predictions from Sr and from Ca plagioclase-liquid partitioning are compared, based on the same experimental results and rock samples, it would appear that the hottest Sr was associated with the coolest Ca, and vice versa! This is almost certainly a compositional rather than a kinetic effect. A simple first approximation at a geothermometer that is largely free of this compositional effect may be the temperature calibrated sum of the Sr and Ca plagioclase-liquid partition coefficients.

Drake, M.J. and D.F. Weill (1975), GCA 39, 689.

Acknowledgement: This work was supported by NASA Grant NSG 5203.

1. 007031PHILPOTTS
2. 1977 Fall Meeting
3. Volcanology, Geochemistry and Petrology.
4. None
5. No
6. No
7. 0%

The purpose of the work carried out under NSG-5203 was to collect data obtained at Goddard and to complete analyses started at Goddard in order to maximize the scientific yield of the geochemistry program which was terminated in 1977. We are pleased to report a high degree of success in meeting these goals.

The major analytical task undertaken has been to complete Gd analyses on a large number of samples already analyzed by mass-spectrometry for other rare earth element abundances at Goddard. Gd values are important for pinning down the central part of the geochemically significant rare-earth abundance pattern and are especially useful in the high precision definition of the utilitarian Eu anomaly. This analytical task required the rather formidable job of setting up a solid-source mass-spectrometer facility, a feat taking considerable time and effort. We have obtained isotope-dilution Gd abundances for thirty-nine samples. These abundances are listed in Table 1. The data are for twenty-seven partition-coefficient samples, six Apollo 15 and 16 breccia samples, four terrestrial impactites, and associated rock standards.

It is not our intention to publish these Gd determinations together in a single paper. The determinations for phenocryst-matrix pairs will probably be reported along with other partition coefficient work we are starting with support from NSF. The lunar data probably will be reported along with other Apollo 15 and 16 analytical data obtained at Goddard and with other lunar data being obtained under our 1979 lunar sample grant. Any lunar data not so published will be transmitted to Houston for inclusion in the

lunar sample data bank. The study of the Zhamanshin impact material, both microprobe analyses for major elements and mass-spectrometer analyses for trace elements, is now essentially complete and we intend to put together a paper giving these results. We will forward reprints of all papers stemming from work under NSG 5203.

The major accomplishment in data synthesis under the grant is the providing of a much better understanding of how elements partition between minerals and silicate melts. Details of this work are included in the abstract and paper listed in the bibliography (copies attached). Briefly, it appears that the logarithm of the mineral-melt partition coefficient is a linear function of ionic radius in the general case. The slope of this function is independent of valence. These results caution against overly simplistic utilization of partitioning in geothermometry, etc. At the same time they hold out enormous promise for understanding non-ideal variations in phase thermodynamic parameters in terms of lattice strain.

Bibliography

Philpotts, J.A. "How Hot Plagioclase?" (Abstract)
EOS 58 (1977) p. 1243

Philpotts, J.A. "The Law of Constant Rejection"
Geochim. Cosmochim. Acta 42 (1978) 909-920

TABLE 1

Gd abundances in ppm by weight

Sample:	GSFC #184 P	0.147
	GSFC #184 M	3.75
	GSFC #184 H	0.250
	BCR-1	6.56
	HHP-66-19 Ol	0.104
	HHP-66-19 Cp	2.39
	GSFC #193 P	2.00
	GSFC #25 M	9.23
	GSFC #25 Ol	0.0686
	GSFC #25 AA	3.93
	BCR-1	6.66
	GSFC #266 M	7.48
	GSFC #266 F	0.136
	HHP-66-19 MCB	0.470
	HHP-66-19 Plag	7.46
	GSFC #240 M	3.04
	GSFC #225 M	6.28
	GSFC #240 F-1	0.0322
	GSFC #218 M	4.41
	GSFC #193 B	0.221
	GSFC #45 H	4.23
	GSFC #218 B	0.298
	GSFC #45 B	12.0
	GSFC #193 M	6.79
	GSFC #218 F	0.449
	GSFC #218 G	50.2
	GSFC #225 F	0.164
	ARP II Anor	0.259
	ARP II Gab	0.248
	Apollo 15505,31	6.23
	Apollo 61175,168	10.2
	Apollo 61175,131	2.46
	Apollo 61175,147	7.01
	Apollo 61175,170	0.203
	Apollo 61175,126	1.60
	Zhamanshin R2S-13	0.148
	Zhamanshin R2S-8	3.06
	Irgizite 1-17	2.98
	Irgizite 1-26	2.99